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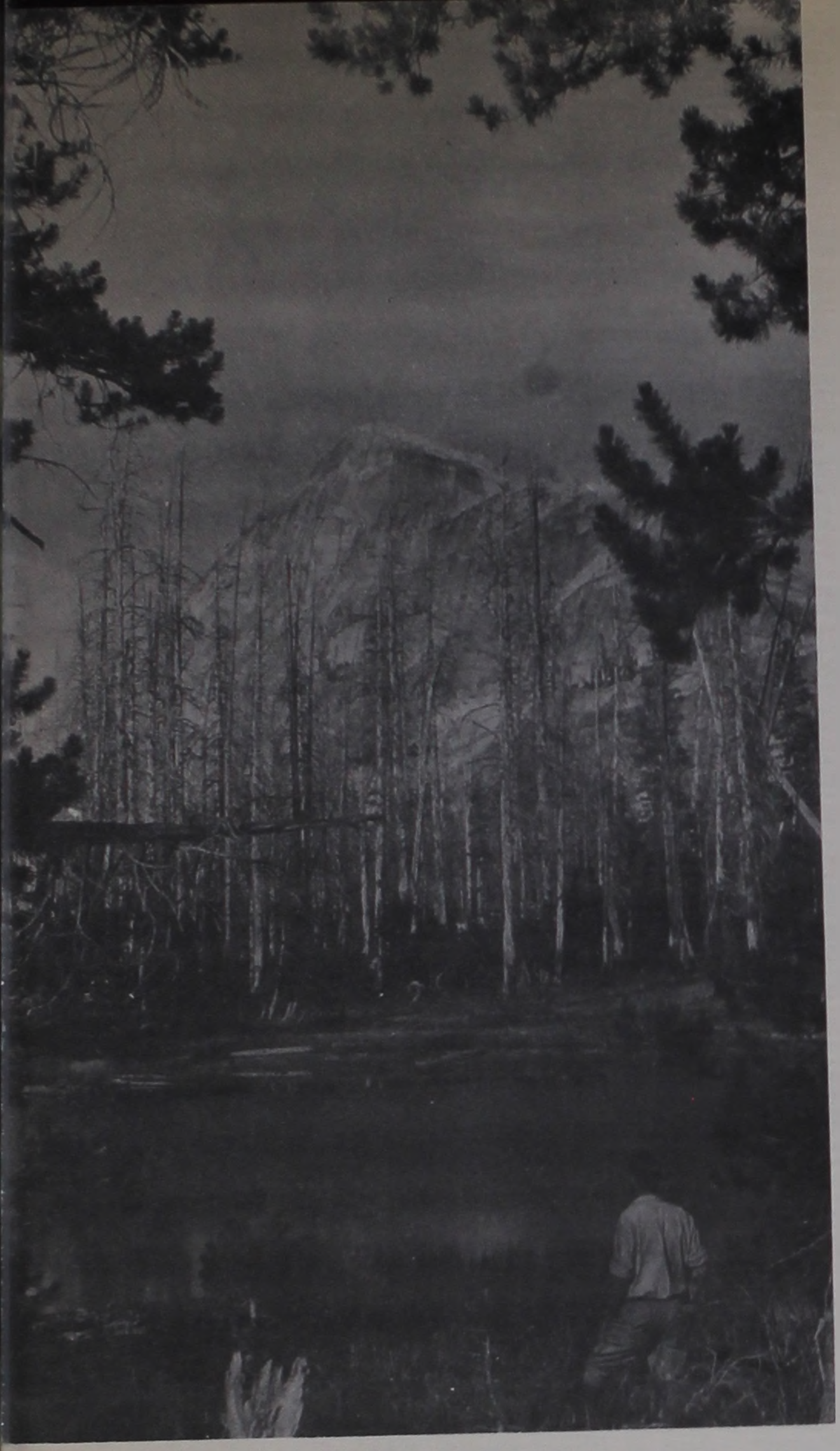

Everyone who drives along the Tioga Road in Yosemite National Park wonders why the forests are sickly—the foliage so brown—why vast areas of trees are thin, gray, or dead.

Tioga's Ghosts

THESE TREES ARE THE VICTIMS OF A TINY MOTH—the lodgepole needle miner. Its caterpillars live nearly two years inside the pine needles. Billions of them hollow first one needle, then another. Eventually they kill all the needles and the trees die.

No newcomer to the high Sierra forest, this native forest pest attacks only lodgepole pine. It infests trees of all ages, but old stands usually suffer the most damage. Periodically the needle miners almost vanish, and new forests grow up among the bleached snags, only to succumb to yet another outbreak. An invading cycle may last 15 or more years, then subside for several years. No one can say how long this has been going on, but the present outbreak is known to be the third since 1900.

Miscellaneous
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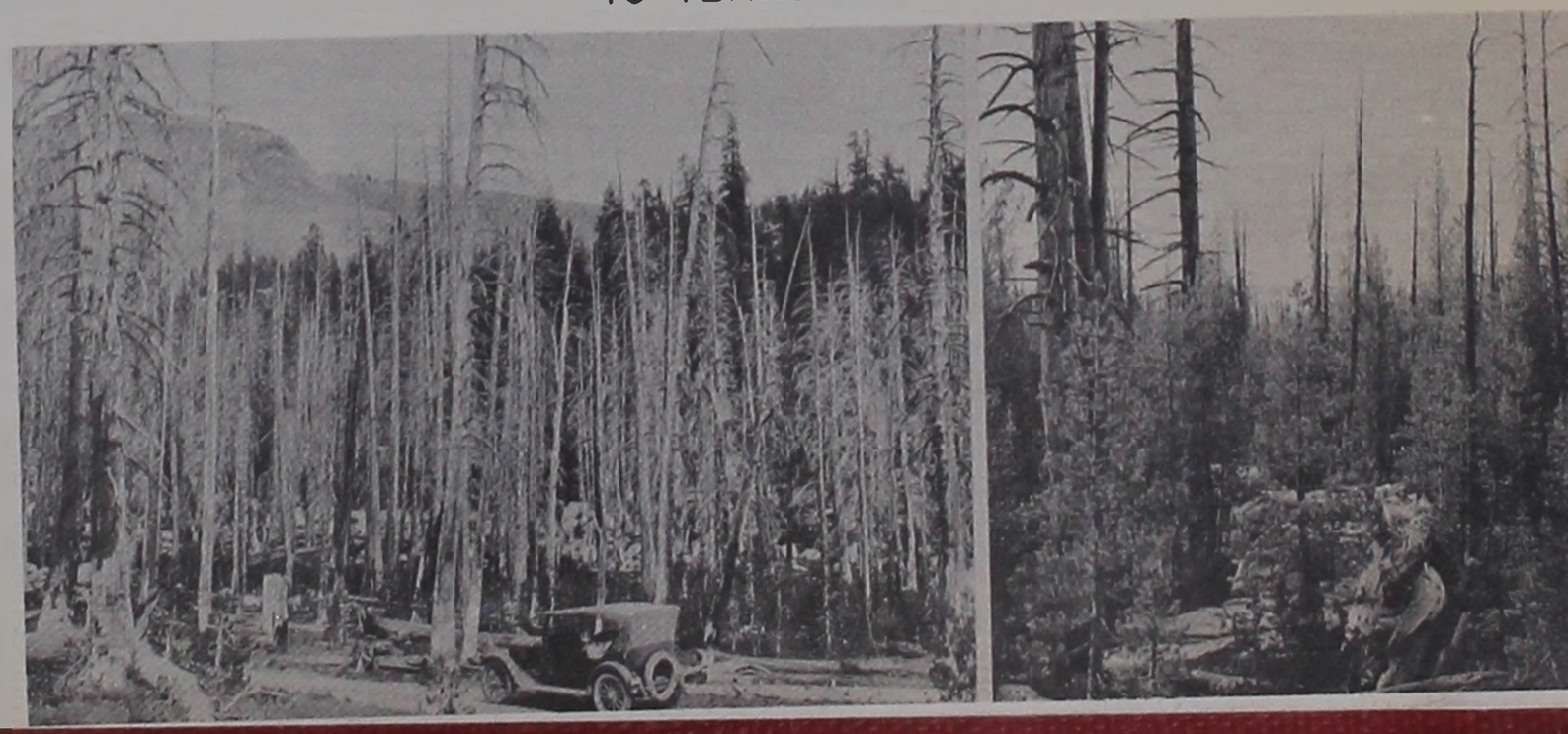
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

in cooperation with

YOSEMITE NATIONAL PARK
NATIONAL PARK SERVICE

40 YEARS AGO - TODAY

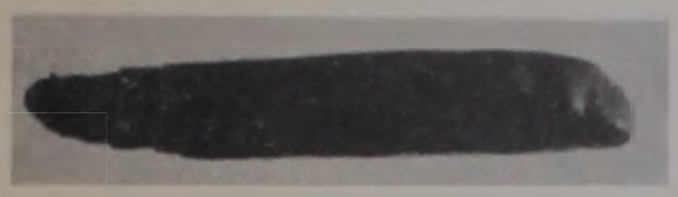


THE LIFE AND TIMES OF A MINER

We know from past research pretty well how the needle miner develops as an individual. It passes through four stages. Let's start with...

EGGS—barely visible yellowish specks, laid by the moths in groups of 2 or more eggs inside mined needles. They incubate for 35 days, then hatch in September, and become--

CATERPILLARS—each bores into and feeds on a live needle, kills the needle, and transfers to another. This goes on for 21 months until no less than 5 needles are destroyed. Then the fully developed caterpillars stop in the last-mined needles and transform to--

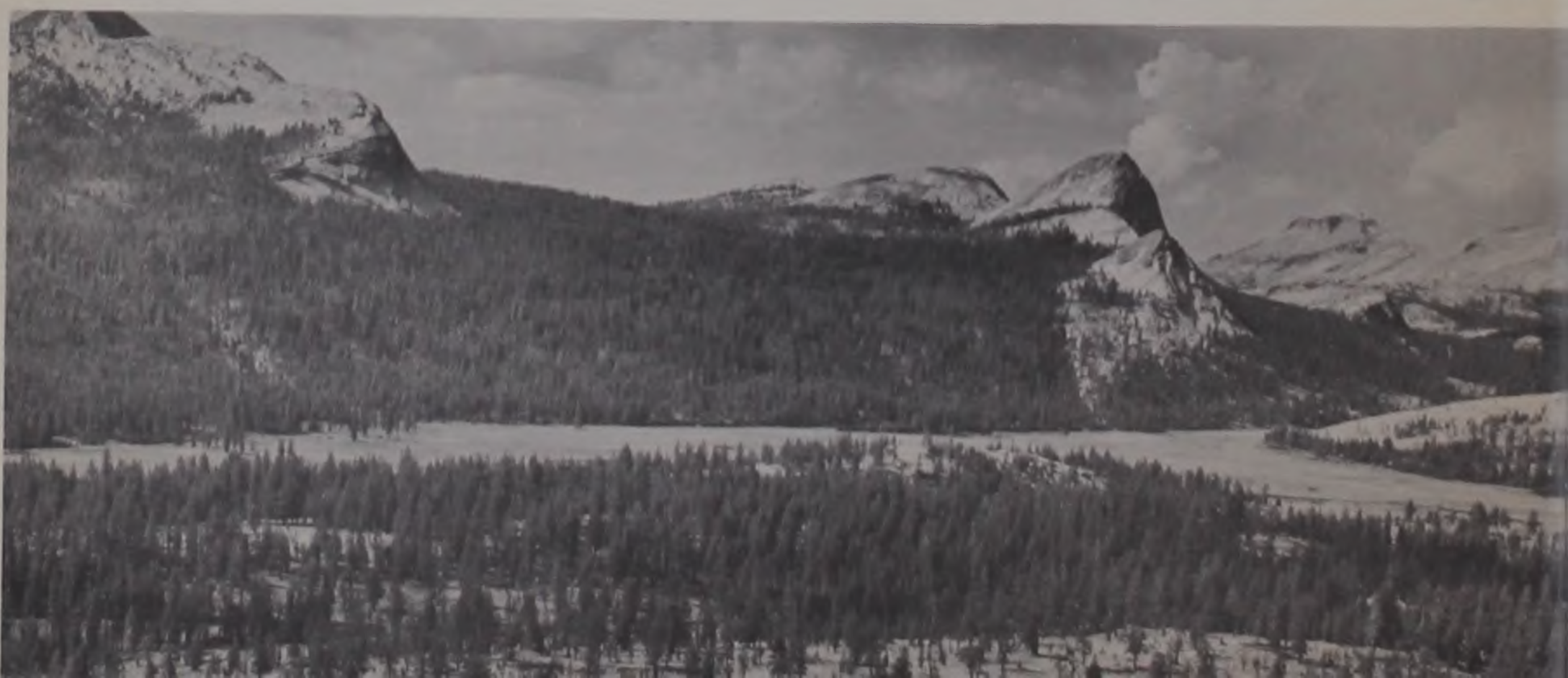


PUPAE—jet-black and smaller than rice grains. They rest about 5 weeks in this stage. Then from the needles emerge--

MOTHS—no larger than clothes moths. In July and August of odd-numbered years, thousands of these gray moths can be seen fluttering among the trees around Tuolumne Meadows. Many drop and accumulate on the surface of pools; others fall into camper's frying pans or alight on their food. The moths mate, lay eggs, and die, but the eggs soon produce a new crop of caterpillars and the cycle starts over again.

The needle miner threatens these lodgepole pine forests surrounding scenic Tuolumne Meadows with slow decline and death. The trees are heavily infested. Can they be saved?

TUOLUMNE MEADOWS FOREST

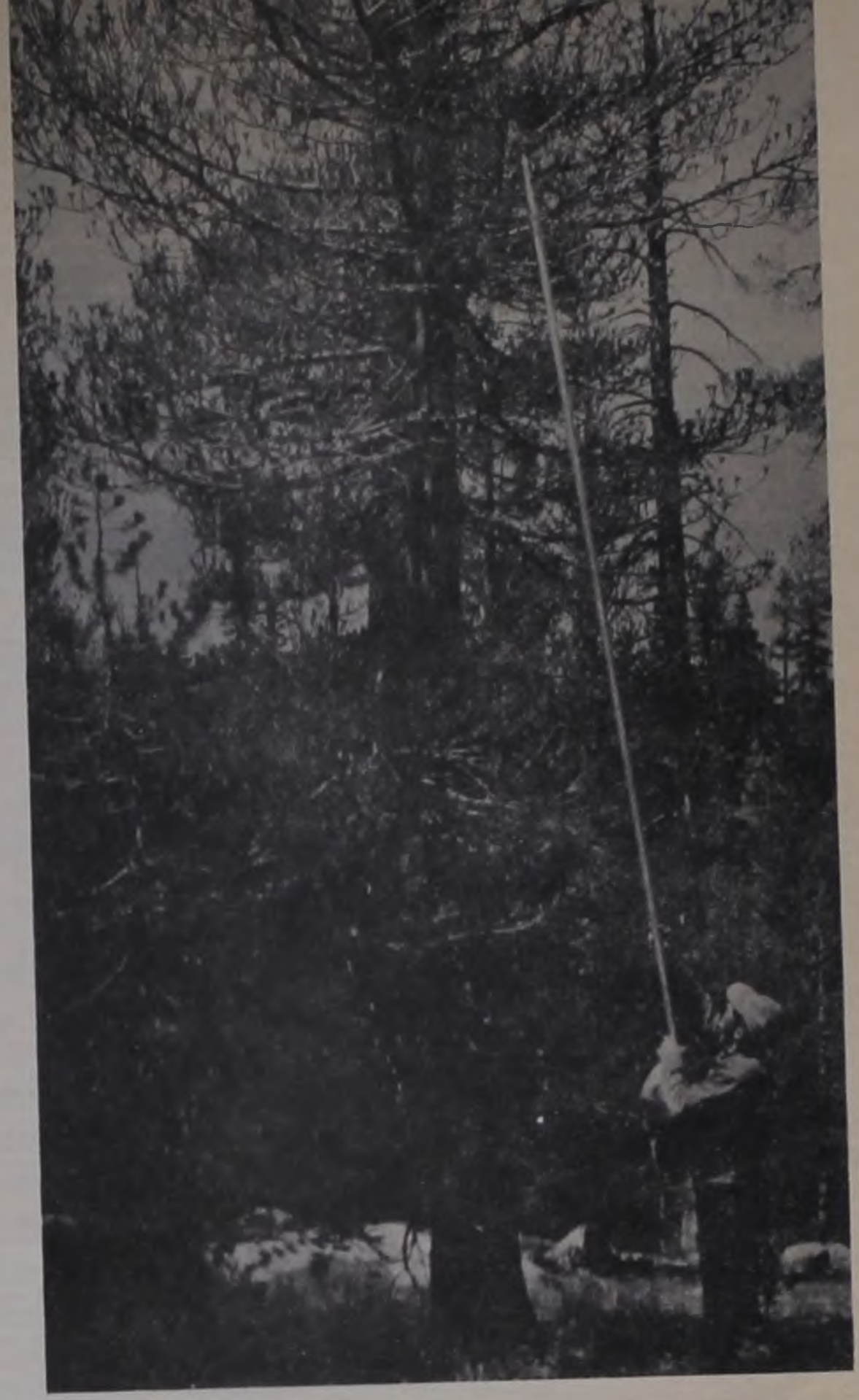


SEARCH SEEKS THE ANSWER

Entomologists are probing the defenses
he needle miner for weak spots—the key
control. By painstaking research they are
hering information about changes in needle
ner abundance and their causes. These
dies must extend over several life cycles.
ey are difficult and time consuming be-
use of the insect's unusually long life cycle,
ich it spends mostly inside the needles.
study the needle miner, entomologists clip
ig tips from the tree crowns, slit open the
edles, and examine the insects under a
croscope.

Nature's own methods of control are
ing investigated with the aid of the Uni-
rsity of California. These studies are
adually unlocking nature's secrets. They
ve shown that other insects prey on the
edle miner; that disease and weather
fect its rise and fall. Research aims to
nd out what the most important influences
e, how they operate, and whether any can
exploited to control the needle miner.
aboratory facilities and special rearing
ages help do this work.

Insecticides that will kill the needle
iner, without harming the park's users and
s abundant supply of fish and wildlife, are
eing sought. Yosemite National Park has
nderway pilot tests of the more promising
prays and spraying equipment turned up by
esearch.



WHAT PROGRESS HAS BEEN MADE TOWARD CONTROL?

Basic to successful control is solid knowledge of the needle miner's life cycle. Research has largely met this need. In the past few years, sampling techniques have been perfected so that we can measure the effects of natural or artificial controls, tell when populations reach damaging levels, and forecast population changes.

We have learned that weather affects needle miner abundance materially. Temperature and air movement influence moth behavior and spread into new areas. Rain and hailstorms knock down many infested needles and bring death to the insects within.

Research has also shown that the needle miner harbors a virus disease, and has many other natural enemies. Forty-three different kinds of insect parasites and predators alone are associated with this pest. Two parasites pictured at right show some promise of being important.

Trees around campgrounds and other choice areas can be protected with sprays. Test plots, like those west of Lembert Dome and on Cathedral Creek west of Fairview Dome, show what insecticides can do. The National Park Service sprayed these plots by helicopter, using malathion in diesel oil, and killed about 75 percent of the needle miners. While the kill is not great enough to prevent reinfestations, it is enough to check the defoliation and keep the trees from dying. Spraying is costly, but so is the loss of these forests. Consequently, the National Park Service seeks to hold the line against the needle miner. Meantime, researchers are looking for cheaper, more selective sprays, and putting more effort into biological control.